The Israeli Journal of Aquaculture - Bamidgeh, IJA.72.2020.1123146 6 pages
https://doi.org/10.46989/001c.19012

The *IJA* is a peer-reviewed open-access, electronic journal, freely available without charge to users
-
Produced by the AquacultureHub non-profit Foundation
Sale of *IJA* papers is strictly forbidden

Parasitological Survey of Cichlidae in the Sea-of-Galilee

Falk R*, Smirnov M, Ofek T and D Cummings

Central Fish Health Laboratory, Department of Fisheries and Aquaculture, Ministry of Agriculture and Rural Development, Nir David, 10803 Israel

Key words: Cichlidae, Myxozoa, Trematode Metacercaria, Prevalence, Littoral Zone

Abstract

The results of a parasitological survey conducted since January 2012 till January 2014 in the littoral zone of the Sea-of-Galilee are presented. The parasites were identified, and their prevalence, density, and geographic distribution were studied. Wet-preparations were used for detection and identification of the parasites. In the described time period, a total of 200 adults and 200 fingerlings of the following fish species *Sarotherodon galiaeus* (68%), *Tilapia zillii* (20%) and *Oreochromis aureus* (12%). The fish were collected from four dispersed coasts of the lake. The primary results of the survey indicate that 30% of examined fish were infected with ciliates. The prevalence of myxozoa was 18% in adults, mostly in the spleen, and was lower in fingerlings, exhibiting prevalence of only 8%. High prevalence of trematode metacercaria was found in fingerlings, (85%), significantly higher than in adults (36%). The most common trematode metacercaria found were *Neascus* sp. and *Bolbophorus* sp. These parasites were found mostly in the brain and eyes. Surprisingly, the following trematodes: *Clinostomum, Euclinostomum, Neascus* and *Bolbophorus*, which were missing in the previous study conducted on 1999-2002, were commonly found in the current study. In light of the findings of the present study as compared to previous ones, it seems that there is a change in metacercaria species throughout the years. It is likely that the changes in the composition of the parasites population found in this survey are related to changes in habitat conditions that affected the survival of the intermediate host communities.

* Corresponding author: Rama Falk, Email: rama.falk@mail.huji.ac.il

Introduction

The Sea-of-Galilee (lake Kinneret) is the only natural freshwater lake in Israel. The water in this lake are prone to human over-exploitation of water resources, that leads to increased annual and interannual fluctuations of water levels, at times far beyond natural amplitudes and/or at altered time schedules (Zohary and Ostrovsky, 2011). In recent years (2008 till 2011) the total catches of fish in the Sea-of Galilee was reduced from an annual average of about ~1,100tones (627 tones, when not including *Acanthobrama terraesanctae*) to about 369 tones (307 tones when not including *A. terraesanctae*) ;

The catch of *Sarotherodon galilae*us (St. Peter's fish) reduced from an annual average of about 200 tones (2000-2008) to 8 tones in 2008 (Non-published data, Department of Fisheries and Aquaculture, Ministry of Agriculture and Rural Development). In addition, when fisherman working in the Sea-of-Galilee reported a phenomenon of 'blindness' on 2011, it became a source for concern for professionals as well as for the public health. In histopathological sections of affected eyes, multiplegranulomas were inspected, some exhibiting myxozoans and others trematode-metacercaria. These findings were in accordance to previous studies that related metacercariae to damage to the eyes of fish (Paperna, 1996).

Species richness of fish-parasite-communities is commonly used as bioindicators for monitoring the state of aquatic ecosystems: seas, lakes and rivers (Djikowski et al., 2003a). Trematode metacercariae, being heteroxenous parasites, depending on multiple intermediate hosts, that are representing multiple ecological niches, are commonly used as sensitive biosensors for these changes (Djikowski et al., 2003c).

Considering the dramatic changes in this lake and the histological findings, it was important to collect data on the parasites of cichlids, and to compare this data to previous studies conducted in the Sea-of-Galilee.

Materials and Methods

Sampling

Fish samples were collected during 2012 in the littoral zone on four main locations at the Sea-of-Galilee, scattered around the lake (32º42'15''N, 32º53'44''N and 35º30'52''E, 35º38'55''E):

1. Ginosar on the north-west side,
2. Ein-Gev on the east side,
3. Kineret-Moshava on the south-west side,
4. Sfamnun river basin on the north-east side.

Samples were collected from January 2012 till January 2014, and each location was sampled three or four times throughout this period. Fish were caught with cast nets and traps and brought alive to the Central Fish Health Laboratory for examination. All fish were assessed for total length and weight. This study was approved by the Israeli Ethical Care and Use of Laboratory Animals Committee.

Parasite- evaluation

Wet preparations of the gills, brain, eyes, kidney, liver, intestine, spleen and skin were examined under a light microscope for detection and identification of parasites. Prevalence (number of infected animals/total animals) and intensity (number of individuals of a parasite species in each infected host) of infections were recorded in accordance with the definitions provided by Bush et al. (1997) and by Noga (1996).

Authors are required to assure the following: (a) experiments are reproducible; (b) quantitative results derive from at least three replicates; and (c) differences between replicates are not due to random variation.

Results

General information regarding fish samples

The fish were sampled from four dispersed locations: north-west, north-east, east, and south-west. All fish were caught from the littoral zone. Adult Cichlidae and fingerlings exhibited mean total lengths of 18.6 ± 2 cm and 4 ± 0.5 cm and mean weight of 133 ± 12 g and 3 ± 0.4 g respectively. Cichlidae included *Sarotherodon galilaeus* (68 %), *Oreochromis aureus* (12 %) and *Tilapia zilli* (20 %).

Phylum Ciliophora

The prevalence and infection-intensity of parasites from this phylum are presented in **Table 1**. The parasite *Ichthyophthirius multifiliis* was found in the gills of 10 % of adult fish on March, when water temperature in littoral zone was 24 ºC. In the same sample, *Chilodonella* sp. was found in 32 % of the fish, on the skin and gills. These parasites were not found in other samples.

Phylum Myxozoa

High infection intensity of myxozoans was found in the gills of fingerlings with prevalence of 7 %, as presented in **Table 2**. Whilst in adult's prevalence of 17 % was found in the spleen, and only 8 % in the gills.

Digenea (Phylum Platyhelminthes)

Table 3 summarizes prevalence and infection level of digenean parasites in different organs of adult fish. The overall prevalence of adult fish with digeneans was 36 %. The overall prevalence of digenea in fingerlings was higher, and was estimated as 85 %. The prevalence of various trematode-metacercaria is depicted in **Table 4**. Infection-intensity in fingerlings was high (data not shown), and about 50% of them were infected with more than one species of trematode metacercariae in one or more organs, as presented in **Figure 1**.

Table 1 Infection-Intensity and prevalence of ciliates (gills and skin)

Parasite	Mean Infection Intensity*	Prevalence (%)
Epistylis sp.	3	7
Trichodina sp.	3	23
Ichthyophthirius multifiliis	2	12
Chilodonella sp.	1	2

*Intensity was numerically evaluated from 1 (very low) to 5 (very high)

Table 2 Infection-Intensity and prevalence of myxozoans

Organ	**Fingerlings**		**Adults**	
	Prevalence (%)	**Infection Intensity***	**Prevalence (%)**	**Infection Intensity***
Gills	7	4	0.5	2
Spleen	8	2	17	3
Kidney	1.2	2	3	2
Liver	-	-	1	2

*Intensity was numerically evaluated from 1 (very low) to 5 (very high)

Table 3 Infection-Intensity and prevalence of digenea

Metacercaria sp.	Prevalence (%)	Infection Intensity*
Centrocestus sp. (gills)	20	2
Sanguinicola sp. (heart)	17	3
Euclinostomum sp. (kidney)	5	V
Unidentified Metacercaria 1 (Liver)	3	ND
Unidentified Metacercaria 2 (Liver)	3	ND

*Intensity was numerically evaluated from 1 (very low) to 5 (very high);
(V) Variable levels of infection; (ND) Not Determined

Table 4 Prevalence of trematode-metacercaria in fingerlings (%) in various organs

Metacercaria sp.	Peritoneum	Brain	Kidney	Liver	Gills	Body	Eyes
Bolbophorus sp.	9	10	1	1	ND	ND	30
Neascus sp.	3	3	1	ND	22	45	8
Clinostomum sp.	8	ND	ND	ND	8	9	ND
Centrocestus sp.	ND	ND	ND	ND	30	ND	ND
Euclinostomum sp.	4	ND	24	ND	ND	ND	ND
Unidentified Metacercaria	15	6	3	5	19	17	5

(ND) Not Detected

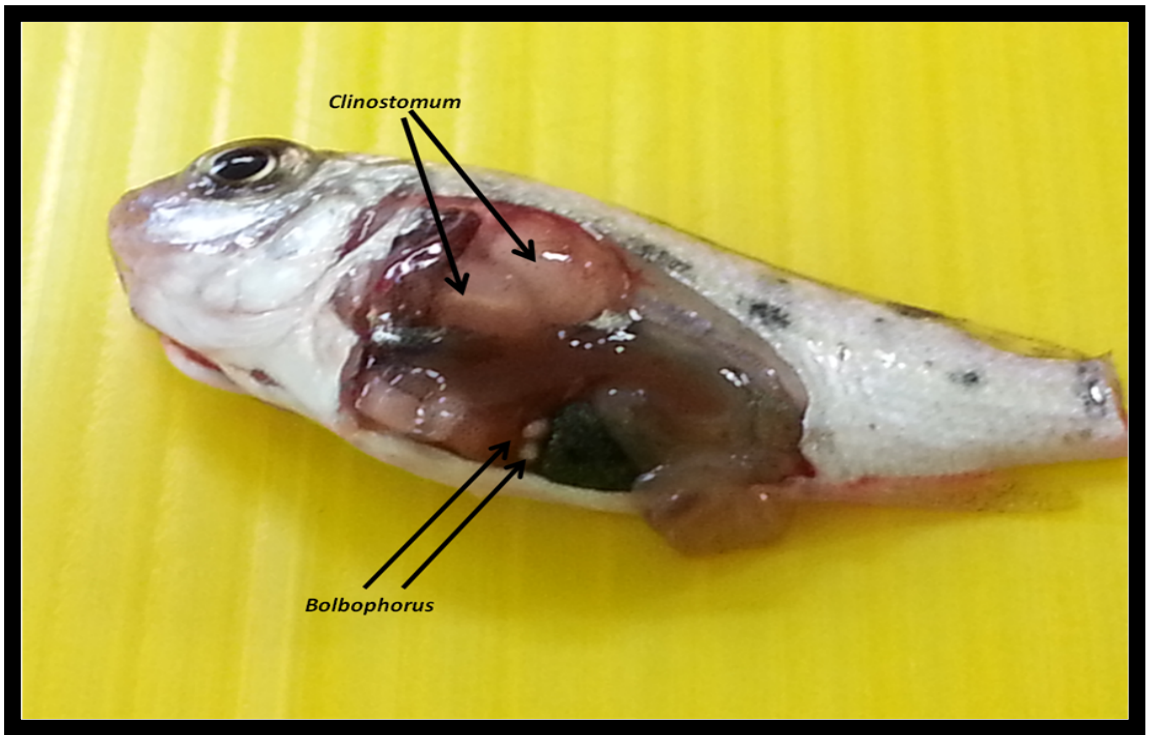

Figure 1 Cichlid infected with both *Clinostomum* sp. and *Bolbophorus* sp.

Discussion

- The parasites *Ichthyophthirius multifiliis* and *Chilodonella* sp., both seasonal parasites, were found on March, however were not found in other excursions.
- *Sanguinicula* sp. infections of the heart in adult cichlids were found in high prevalence (10 %) and high levels of infection. These data are in accordance with previous reports (Paperna, 1964). This parasite caused mortalities in cichlids in the Sea-of-Galilee and Jordan-river-basin during the 90th (Paperna 1996).
- Prevalence of trematode metacercariae in fingerlings was found to be very high (91.4 %), as compared to its prevalence in adults (48 %). Prevalence data and host records hint that infestation by metacercariae occurs only, or predominantly, in shallow waters where most vector snails live. In lakes such as Lake Kinneret, infections are common and high only among young fish, or species confined to shallow water (Paperna, 1996). Older fish, in the offshore water were sparsely or exceptionally infected. The only exception are fish that apparently spend part of their time close to the shore.
- High prevalence of fingerlings infected in more than one organ and with more than one trematode metacercariae species, was common. The infections were in multiple organs and sometimes more than one genus of trematode infected the same fish. In those excursions where high infection levels with trematodes were found, high mortality rates were also noted among the specimens that were maintained in the aquaria for further observation.
- The trematode metacercariae *Clinostomum* sp., *Euclinostomum* sp*., Neascus* sp. and *Bolbophorus* sp., which were absent from the survey of 1990 – 2002 (Dzikowski et al., 2003b), were found to be very prolific in the current survey. The absence of these parasites from the past survey can be explained by the disappearance of their intermediary host; the snail *Bulinus truncatus*. This finding raises questions regarding the recent changes of the lake's ecosystem that allowed for the reappearance of the parasites.
- Trematode infection of the eyes and brain were also very common among fingerlings (42 % and 13 %). A connection between these infections and the blindness phenomenon is possible as it is known that trematode metacercariae infections of eyes can cause the formation of an opaque film around the infected eyes (Paperna, 1996; Nordic council of ministers, 2009). This connection will be further examined under laboratory conditions.

Acknowledgements

This research was supported by a grant to Dr. R Falk and M Smirnov from the Israeli Ministry of Agriculture and Rural Development. We acknowledge the lab assistance by N Davidovich.

References

Bush, A. O., K. D. Lafferty, J. M. Lotz, and A. W. Shostak, 1997. Parasitology meets ecology on its own terms: Margolis et al. revisited. Journal of Parasitology 83: 575-583.

Dzikowski R., A. Diamant and I. Paperna, 2003a. Trematode metacercariae of fishes as sentinels for a changing limnological environment. *Dis. Aquat.* Org. 55:145-150.

Dzikowski R., I. Paperna, A. Diamant, 2003b. Use of fish parasite species richness indices in analyzing anthropogenically impacted coastal marine ecosystems. *Helgo. Marine Res*. 57:220-227.

Dzikowski R., I. Paperna, A. Diamant, 2003c. Multi-annual changes in the parasite communities of rabbitfish *Siganus rivulatus* (Siganidae) in the gulf of Aqaba, *Red Sea* 57:228-235.

Gasith, A., S. Gafny, And M. Goren, 2000. Response of fish assemblage of rocky habitats to lake level fluctuations: possible effect of varying habitat choice. *Arch. Hydrobiol. Spec. Issues. Advanc. Limnol.* 55, pp. 217-331.

Noga, E.J. 1996. *Fish Disease: Diagnosis and Treatment*. St. Louis, MO Mosby-Year Book, Inc. 17-26.
Nordic Council of Ministers, Copenhagen 2009. Looking fish in the eye - cataract as a problem in fish farming.
Paperna I. 1964. The Metazoan Parasite Fauna of Israel Inland Water Fishes. *IJA-Bamidgeh* 16:1-66.
Paperna I. (1996) Parasites, Infections and diseases of fishes in Africa-an Update. Technical Paper 31. *Central Institute of Freshwater Aquaculture, Food and Agriculture Organization*, United Nations, Rome.
Paperna I. (ed) 199) Fish parasites as indicators of environmental quality. *Parassitologia* 93:168-255.
Zohary, T., and Ostrovsky I. 2011. "Do water level fluctuations matter?" *Inland Waters* 1: 47-59.